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(58) Field of search
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B1T
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(54) Duplex filter

(57) Two filters 1, 2 are connected in parallel, and only filter 1 is provided with a movable backflushing nozzle 12. Valve 5 normally directs flow through filter 1, until rising pressure necessitates switching the flow through filter 2 while filter 1 is backwashed. Thereafter flow is restored through filter 1. The element 14 in filter 2 is periodically replaced when dirty. In Fig. 1 the flow switching is automatically controlled by pressure drop monitor 17, and the backwashing of element 13 is effected by nozzle 12 which rotates as it is advanced axially inside element 13 (Fig. 2, not shown) by a piston 22 for a period determined by restrictor 37. In Figs. 3, 4 the switch over and nozzle movement are effected manually.

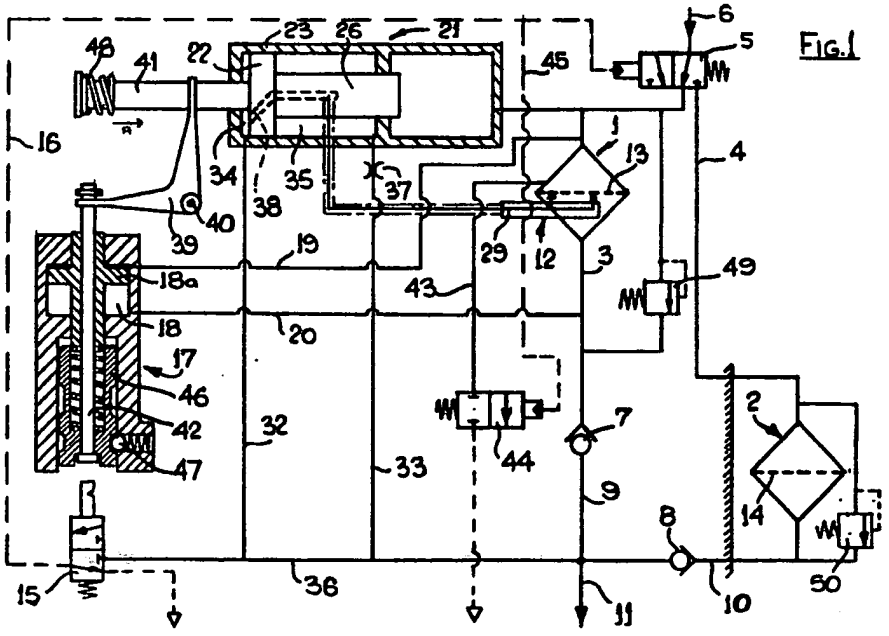

Fig.1

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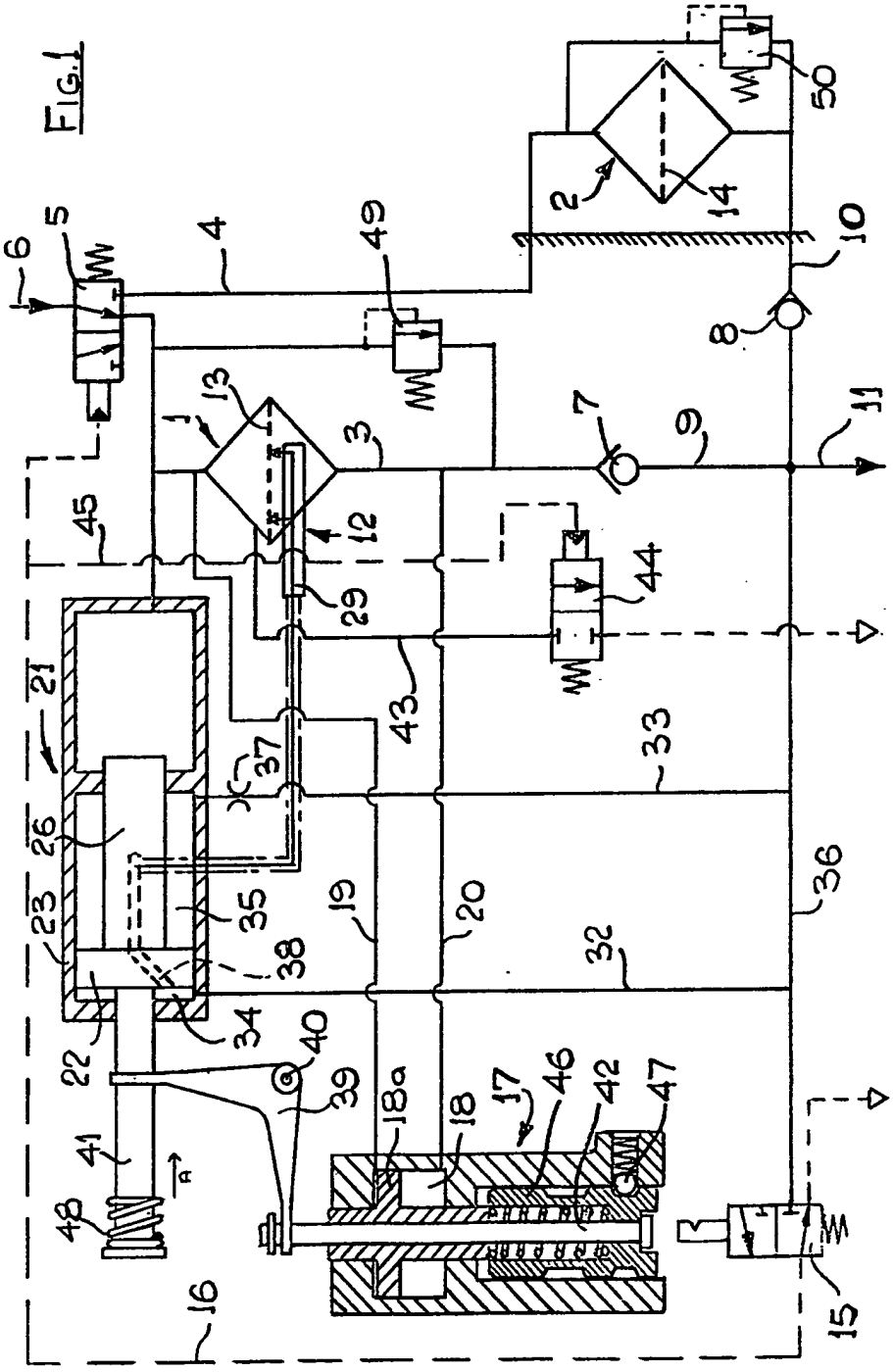
FIG.1



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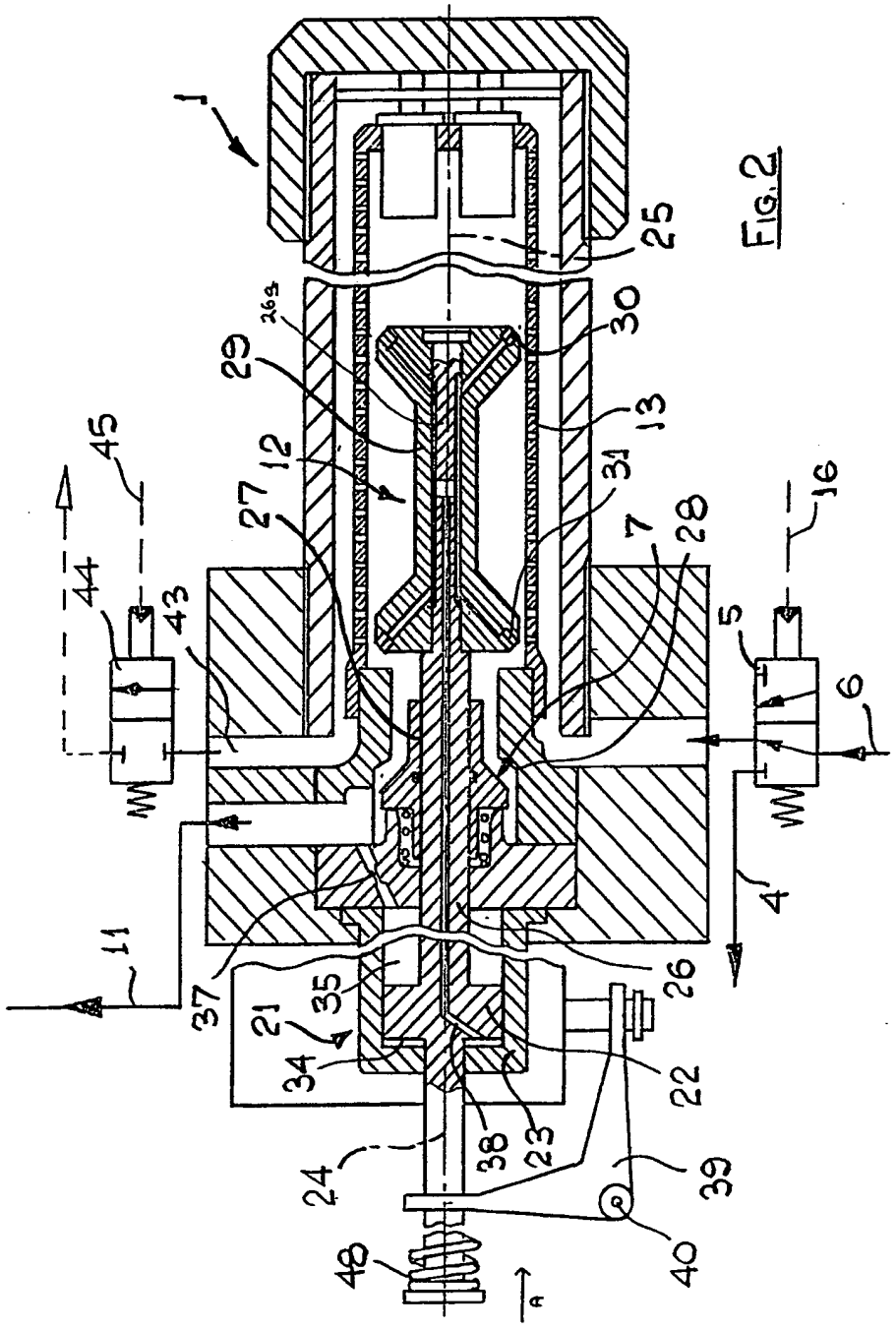

FIG.2

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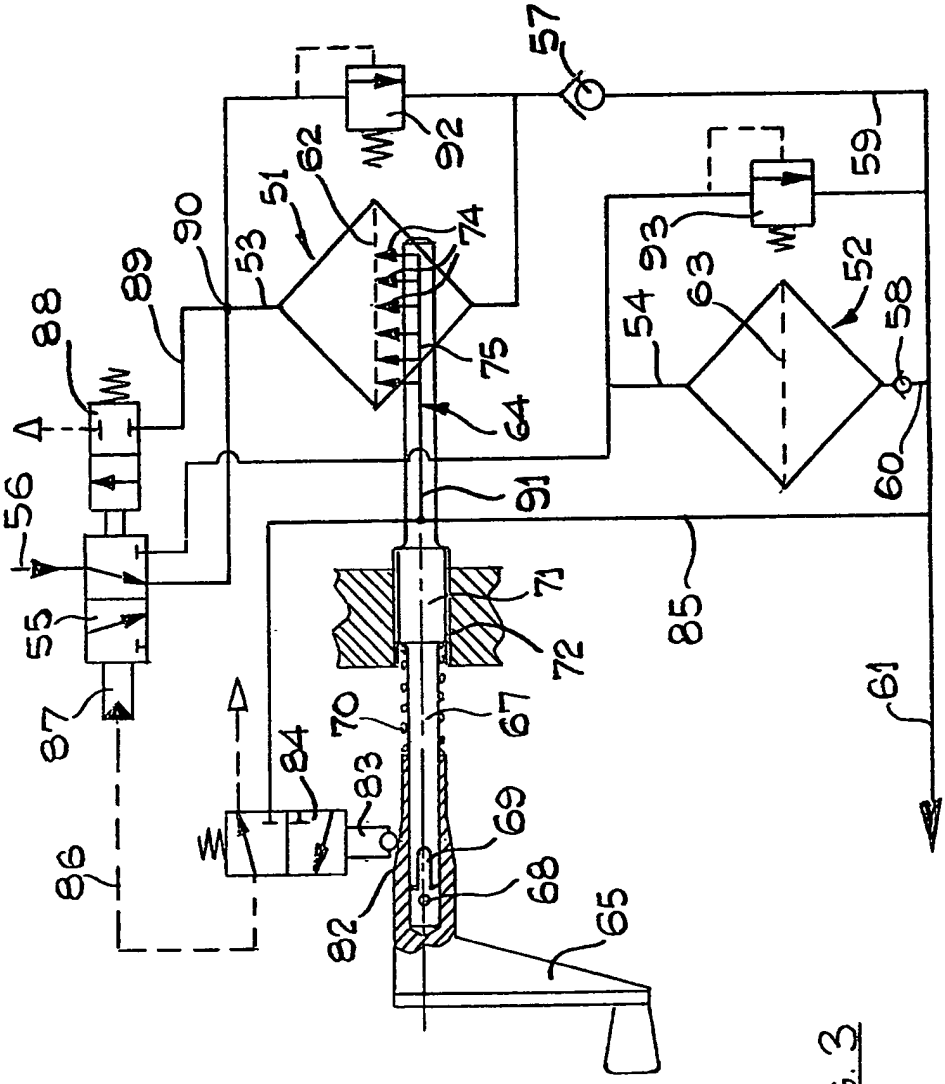
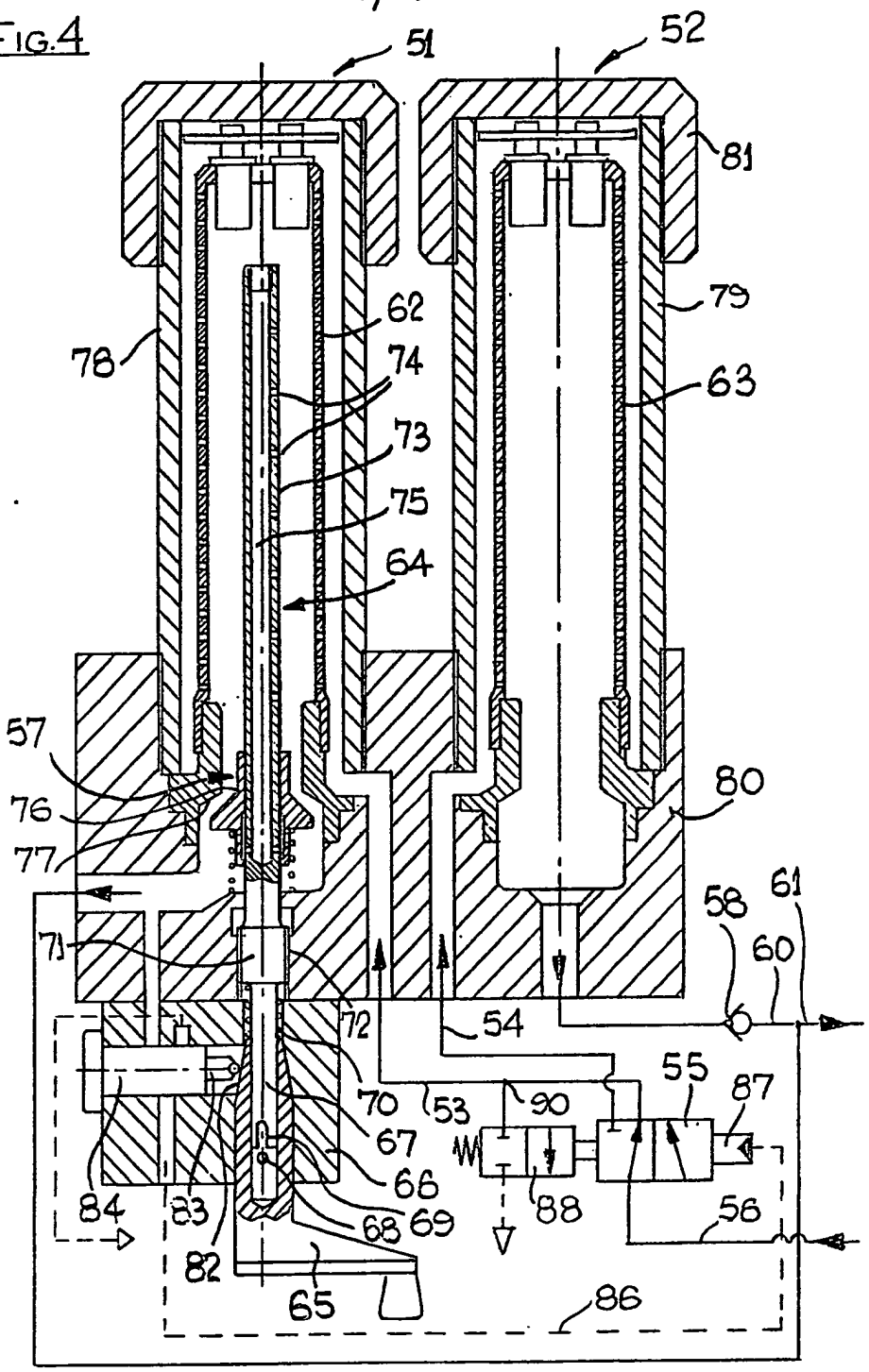


FIG. 3

FIG.4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SPECIFICATION

Fluid filtering systems

This invention relates to fluid filtering systems and in particular to fluid filtering systems for use in the water supply systems of mines.

Known types of fluid filtering systems include two identical filter units arranged in parallel with only one unit in service at any time. This enables the unit which is out of services to be cleaned, repaired and/or otherwise maintained. It has previously been proposed that the cleaning of filter units may be effected by back-flushing of the filter element with a high pressure fluid, and suitable means for achieving this has been provided in each filter unit.

The provision of back-flushing means in both filter units, and the duplication of equipment associated therewith, is costly in terms of capital expenditure and space. It would therefore be beneficial to reduce the duplication of equipment to a minimum.

In accordance with this invention a fluid filtering system comprises two filter units arranged in parallel and having means to cause, in use, fluid to flow through one of the two units at any one time, wherein one of the two units is supplied with back-flushing means and the other is supplied with a replaceable filter element to allow for cleaning of the unit which is not in use

The fluid filtering system is, preferably, provided with means for sensing the degree of contamination of the filter unit provided with back-flushing means when this unit is in service. The sensing means operates so that when the degree of contamination has reached a level where the filter unit is no longer in a suitable condition for continued service, the sensing means automatically causes the filter unit to be by-passed and the filter unit having the replaceable element to be brought into service during the cleaning of this filter unit.

Timing means may be provided for automatically controlling the period of time during with the filter unit having back-flushing cleaning means is out of service for cleaning.

As an alternative to the automatic sensing means, manually-operable means may be provided whereby when the degree of contamination of the filter unit having back-flushing means is of a level such that the filter is no longer suitable for continued service, the operation of the manually-operable means effects by-passing of that filter unit, and brings the filter unit devoid of back-flushing means into services and initiates the back-flushing of the filter unit now out of service.

The filter element of each filter unit can advantageously be of cylindrical form.

Preferably the back-flushing means comprises a rotary member disposed at least partly within its respective filter element and mounted for rotation with respect thereto. In this case the rotary member may carry ejection means, though which high pressure fluid is discharged to effect rotation of the rotary member, together with further ejection means through which high pressure fluid is also discharged and directed through the cylindrical wall of the respective filter element to effect cleaning thereof by back-flushing in the direction opposite to the direction of normal filtering flow therethrough. The rotary member may be so adapted as to be traversable or moveable longitudinally within the respective filter element, such movement being effected either automatically or manually.

The advantages offered by the invention include the fact that only one of the filter units need be provided with means for back-flushing and therefore substantial savings in the cost of the system are obtained.

Two examples of the invention are described below with reference to the accompanying drawings in which;

Figure 1 is a schematic representation of a fluid filtering system in accordance with the invention which includes two parallel filter units,

Figure 2 is a cross-sectional elevation of one of the two filter units shown in Fig. 1,

Figure 3 is a schematic representation of a further fluid filtering system in accordance with the invention which includes two parallel filter units, and

Figure 4 is a cross-sectional elevation of a specific construction of the two filter units of Fig. 3.

With reference to Figs. 1 and 2 of the drawings, a fluid filtering system, which is intended for continuous use with, for example, liquid-pressure-operable mining equipment includes two filter units 1 and 2 arranged in parallel in flow lines 3 and 4; a two-position selector valve 5 which is capable of conducting high pressure liquid in inlet flow line 6 into either the flow line 3 or the flow line 4; non return valves 7, 8 to enable discharge from the filter units through lines 9, 10, and outlet flow line 11 to which the lines 9, 10 supply discharge fluid from the filter units, with back-flushing cleaning means 12 in filter unit 1 and a replaceable filter element in filter unit 2.

Filter unit 1 is provided with a porous filter element 13 with is cleaned by the back-flushing cleaning of the unit. Filter unit 2 is a standard type of unit which has a porous element 14 which may be easily removed and replaced. In this fluid filtering system both of the filtering elements 13, 14 are of cylindrical form.

A selector trip valve 15 is associated through pilot line 16 with selector valve 5, while a pressure differential sensor with trigger unit 17, which is co-operable with valve 15, is provided in association with filter unit 1. The sensor section 18 of unit 17 is re-

sponsive through lines 19, 20 to the existing pressure differential across filter unit 1, and when this exceeds a predetermined value the piston 18*a* of this section moves downwardly so that valve 15 is caused to operate, this in turn effecting operation of valve 5.

A timer in the form of a dash-pot device 21, comprising a piston 22 movable in cylinder 23, is arranged as shown in Fig. 2 with its longitudinal axis 24 coincident with the longitudinal axis 25 of element 13. Piston rod 26 of the piston 22 extends to the right in Fig. 2 into the interior of element 13 and displaceable element 27 of non-return valve 7 is mounted on the rod 26 and is spring-loaded on its seating 28.

At end 26*a* the rod 26 carried a spool 29 which form part of the back-flushing means 12. This spool is rotatable about axis 25 as a result of thrust developed by liquid discharge from the interior of the spool through reaction nozzles 30. The spool also includes cleansing nozzles 31 through which liquid can be discharged from the interior thereof, so that the liquid passes through the wall of element 13 in the direction opposite to the flow of filtering fluid, thereby washing away particles of contaminant adhering to the cylindrial exterior surface of the element.

As shown in Fig. 1, lines 32, 33 are respectively connected between chambers 34, 35 on each side of piston 22 and line 36 which itself connects line 11 to trip valve 15. A flow restrictor 37 is provided in line 33, and a passage 38 in piston 22 and rod 26 provides a flow route by which liquid in chamber 34 can pass into the interior of spool 29 and thence out through nozzles 30, 31.

A bell-crank lever 39 is pivotally mounted at 40 to an adjacent structure (not shown) and is co-operable with the rod extension 41 from piston 22 so that, when the piston reaches its extremity of travel in direction A, through-rod 42 is lifted to allow the displaceable element of valve 15 to return to the positon shown in Fig. 1. A line 43 is taken from unit 1 at a point upstream of the element 13 thereof to a dump valve 44 shown closed in Fig. 1 and then to dump. When pilot line 15 is pressurised, a signal is transmitted via line 45, which is branched from line 16, to dump valve 44 to open it and permit cleaning liquid carrying the contaminant to pass to waste.

During operation of the filtering system with filter unit 1 operative, filter liquid can pass through inlet flow line 6 to outlet flow line 11. When filter element 13 is contaminated to a degree in excess of the preset valve, the resultant increase in pressure differential across the filter element, which is sensed by the sensor 18, causes spring-loaded element 46 to move downwardly, riding out of detent mechanism 47 and engaging trip valve 15 so as to move its displaceable element downwardly. Therefore the line 36 is opened to line 16 and selector valve 5 changed-over so that liquid in the inlet flow line 6 is caused to pass through line 4. Thus flow from line 6 to line 11 will take place through filter unit 2 and isolate unit 1 from line 6.

Clean liquid passing from unit 2 will enter chamber 34 via through lines 36 and 32 and, due to the pressure differential across them, piston 22 and rod 26 will move to the right causing the spool 29 to traverse within cylindrical filter element 13. The time taken for such traverse is dependent upon the nature of the restrictor 37. Simultaneously with the traverse clean liquid present in passage 38 passes through the nozzles 30, 31 causing rotation of spool 29 and back-flushing of the wall of element 13, i.e. in the radial-outward direction, opposite to normal filtering flow. Back-flushing liquid, with contaminant particles, is thereafter discharged to waste through line 43 and the now-open dump valve 44.

Having been cleaned for a period of time which is dependent on the stroke and velocity of piston 22, filter unit 1 is now ready for reentry into service. At its extremity of travel, the piston rod extension 41 operates a buffer spring 48 so as to move lever 39 about pivot 40 and lift through-rod 42 and permit the trip valve 15 to close line 36. Therefore, selector valve 5 moves back to the position shown in Fig. 1 so that "standard" filter unit 2 is isolated from line 6 and the cleaned filter unit 1 is brought back into service.

As pressure dissipates in lines 36, 32, 33 with the resultant low pressure differential across filter element 13 (now sensed by unit 18) pistons 22 and 18*a* return to the positions shown in Fig. 1. Spool 29, no longer rotating, moves back to the position shown in the drawings.

The fluid filtering system described above is automatic and continuous in its operation and since the "standard" filter unit 2 is brought into service only during the period of back-flushing of unit 1 it is used only for relatively short periods. As a result the filter element 14 need only be replaced after several periods of use and a long period of system operation is achieved. The replacement of element 14 is easily and rapidly effected when unit 2 is out of service, or when the system is temporarily shut down.

With reference now to Figs. 3 and 4, a fluid filtering system, which is again intended for continuous use with liquid-pressure-operable mining equipment includes two filter units 51, 52 arranged in parallel in flow lines 53, 54 a two position selector valve 55 capable of conducting liquid under pressure in inlet flow line 56 into either the flow line 53 or the flow line 54 so that one or other of the filter units is brought into operation; non return valves 57, 58 placed in flow lines 59, 60 and an output flow line 61 which is supplied with discharge

liquid via flow lines 59, 60.

The system of this embodiment differs from that of Figs. 1 and 2 in that, instead of being automatically operable by the provision of sensing means and a timer in the form of a dash-pot device, it is manually-operable for change-over from a filter unit 51 to a filter unit 52 either at predetermined time intervals during operation of the system or when it is detected by suitable means (not shown) that contamination of unit 51 has reached an unacceptable state. Following cleaning of the porous element 62 of the filter unit 51 by back-flushing in the manner described below, re-use of the unit 51 is effected manually.

As was the case with the embodiments of Figs. 1 and 2, a porous element 63 of the second filter unit 52 is not provided with means for back-flushing and is readily removable and replaceable when unit 52 is out of service or the system is temporarily shut down. The back-flushing means 64 is operated by a manually-operable crank-handle 65 mounted for rotation in casing portion 66 and upon a shaft 67. The crank handle 65 and shaft 67 have a drive pin 68 and slot 69 connection of a coil spring 70. Rotation of the handle 65 when engaged causes screw-threaded aperture 72 so moving hollow portion 73 of back-flushing means 64 axially within and with respect to filter element 62. A hollow portion 73 is provided with cleansing nozzles 74 with open radially outwardly from a duct 75 within the portion 73.

The displaceable element 76 of a non return valve 57 is mounted on a portion 73 and is spring-loaded onto its seating 77.

As shown in detail in Fig. 4 the filter units 51 and 52 are mounted in parallel with their casings 78, 79 screw threadedly engaged in a common block 80; it can be seen that the element 63 is readily removable from its casing 79 following unscrewing of the cap 81, and can be reaplced very quickly.

The crank-handle 65 is provided with a cylindrical cam portion 82 which is engaged with the displaceable element 83 of a trip valve 84. In Fig. 3 this valve is shown in the position in which it closes a line 85, branched from line 61, from communication with a pilot line 86 taken to the operator means 87 of selector valve 55.

The displaceable element of valve 55 is combined with that of the dump valve 88 disposed in a line 89 branched from line 53 at point 90 upstream of filter unit 51 and taken to waste.

During operation of this filtering system, for example with selector valve 55 in the position shown in Figs. 3 and 4 and with filter unit 51 recieving filter liquid passing through inlet flow line 56 to outlet flow line 61, in the event that the element 62 becomes contaminated more than a predetermined amount, this being determined by means not shown dependent, for example, on the length of service of the system or other suitable means (not shown) the crank-handle 65 is axially pressed so as to compress spring 70 and to engage drive pin 68 with slot 69. Simultaneous displacement of the cam portion 82 effects upward movement of the element 83 so that the trip valve 84 opens to permit liquid from the downstream side fo the filter unit 51 and present in the line 85 to pass into pilot line 86. This powers the operator means 87 which changes over the valve 55 so that liquid in the inlet flow line 56 is no longer delivered into the line 53 and is instead caused to pass throught the line 54. Thus flow from the line 56 to the line 61 will now take place through filter unit 52, that is the "standard" unit which has no provision for back-flushing, the unit 51 is now isolated from the line 56.

The dump valve 88 is opened simultaneously with change-over of the valve 55, thus placing the upstream side of the unit 51 in communication with waste through the line 89. Liquid present in the line 85 gains access through a line 91 diagrammatically shown in Fig. 3 with the duct 75 wihin the portion 73, passing radially-outwardly through the nozzles 74 and back-flushing the cylindrical wall of the element 62, i.e. in the radial-outward direction, opposite to normal filtering flow. Back-flushing liquid, with contaminant particles, is therefore discharged to waste through the line 89 and the now-open dump valve 88. Winding of the engaged crank-handle 65 in either direction will cause axial traverse of the portion 73 in the appropriate direction for continuation of back-flushing.

Release of the handle at any time will permit it to move to the left under the effort of the spring 70 freeing the pin 68 from the slot 69 whereupon the valve 84 will close the line 85 to the line 86. Thus the valves 55 and 88 will move back to their positions shown so that back-flushing of the unit 51 will cease and that unit will automatically be brought into in-line service, while the filter unit 52 will simultaneously taken out of service. Thus the event that the operator fails to maintain required axial pressure thereon due to incapacity, distraction or otherwise.

Suitable by-pass valves 92, 93 are respectively provided in parallel with the units 51, 52.

As with the construction of the first embodiment since the "standard" filter unit 52 is brought into service only during the period of back-flushing of the unit 51 it is used only for relatively short periods. As a result the filter element 63 need only be replaced after relatively long periods of system operation, and such replacement is easily and rapidly effected when the unit 52 is out of service or when the system is temporarily shut down.

Although in the first embodiment described above with reference to Figs. 1 and 2, the

reaction nozzles and cleaning nozzles are separate one from another, in alternative embodiments of the invention such nozzles may be suitably combined.

Further, although in the above embodiments the fluid being filtered is a liquid, in alternative embodiments of the invention the fluid filtered may be a gas.

CLAIMS

1. A fluid filtering system comprises two filter units arranged in parallel and having means to cause, in use, fluid to flow through one of the two units at any one time, wherein one of the two units is supplied with back-flushing and the other is supplied with a replaceable filter element to allow for cleaning of the unit when not in use.

2. A fluid filtering system as claimed in claim 1, which is further provided with means for sensing the degree of contamination of the filter unit provided with back-flushing means when this unit is in service.

3. A fluid filtering system as claimed in claim 1 or claim 2 which is further provided with means for automatically controlling the period of time during which the filter unit having back-flushing means is out of service for cleaning.

4. A fluid filtering system as claimed in claim 1 which is provided with manually operable means whereby when the degree of contamination of the filter unit is no longer suitable for continuing service, operation of the manually-operable means effects by-passing of that filter unit, and brings the filter unit devoid of back-flushing means into service initiates the back-flushing of the filter unit now out of service.

5. A fluid filtering system as claimed in any of the preceding claims, wherein the filter element of each filter unit is of cylindrical form.

6. A fluid filtering system as claimed in any one of the preceding claims wherein the back-flushing cleaning means comprises a rotary member disposed at least partly within its respective said filter element and mounted for rotation with respect thereto.

7. A fluid filtering system as claimed in claim 6 wherein the rotary member carries ejection means, through which high pressure fluid is discharged to effect rotation of the rotary member, together with further ejection means through which high pressure fluid is also discharged and directed through the cylindrical wall of the respective said filter element to effect cleaning thereof by back-flushing in the direction opposite to the direction of normal filtering flow there-through.

8. A fluid filtering system as claimed in claim 6 and claim 7 wherein the rotary member is adapted as to be traversable longitudinally within said respective the filter element, such transverse being effected automatically or alternatively manually.

9. A fluid filtering system substantially as hereinbefore described with reference to Figs. 1 and 2 or Figs. 3 and 4 of the drawings.

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